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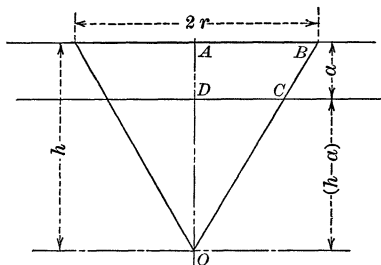
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By Archimedes' principle, we may write,



$$\frac{1}{3} \pi r^2 h w = \left[\frac{1}{3} \pi r^2 h - \frac{1}{3} \pi \frac{r^2 (h-a)^3}{h^2} \right] d_1 + \frac{1}{3} \pi \frac{r^2 (h-a)^3}{h^2} d_2;$$

Then,

$$w = d_1 + \frac{(h-a)^3}{h^3} (d_2 - d_1).$$

For the second position of the cone we must have,

$$w_1 = d_2.$$

Hence, increase of

$$w = w_1 - w = d_2 - d_1 - \frac{(h-a)^3}{h^3} (d_2 - d_1) = (d_2 - d_1) \left[1 - \frac{(h-a)^3}{h^3} \right].$$

QUESTIONS AND DISCUSSIONS.

EDITED BY U. G. MITCHELL, University of Kansas.

At the time of making up copy for this issue no replies had yet been received for Questions numbered 4, 8, 12, 13, 16, 20 and 28.

REPLIES.

27. A certain college wishes to offer twelve hours of mathematics beyond the usual courses in analytic geometry and differential and integral calculus. Considering only the needs of students intending to specialize in pure mathematics, what courses should make up the twelve hours?

Note.—Last month we published a reply to this question by a professor in a middle western college. The reply given below was received while the December issue was still in press. It therefore gives an entirely independent view by an instructor in an eastern university. We hope that our readers will compare the two replies and note the points of agreement.—EDITOR.

REPLY BY R. B. ROBBINS, Sheffield Scientific School, Yale University.

To deal intelligently with the question it must be made more definite. Let us assume that just one year of calculus is presupposed and that an additional twelve-hour curriculum is desired which can be repeated without much modification year after year. With only the interests of prospective students of pure mathematics in mind it seems that such a college might hope to attain two fairly definite ends (I and II below) by means of the courses outlined below:

I. Introduce the student to the general subject matter of mathematics by courses in (*A*) topics in analysis—3 hours; (*B*) modern geometry—3 hours.

II. Give the student some of the standard tools for more advanced work by courses in (*C*) advanced calculus and solution of differential equations—3 hours; (*D*) infinite series, definite integrals and topics in advanced algebra—3 hours.

This doubtless looks rather formidable for a third-year college student; therefore a few words of explanation. In his junior year the student should take courses *B* and *C*, reserving courses *A* and *D* for his senior year.

Course *C* might well contain quite a variety of material. If the student does not have access to a course in mechanics in some other departments it certainly should contain some of the applications of the calculus to mechanics. This is the place to make partial differentiation and certain topics in the integral calculus concrete by application to solid analytic geometry. The solution of the commoner types of differential equations should also be included here.

Course *B* can be made as difficult and dull or as easy and inspiring as the instructor desires. If the student is led gradually into the meaning and importance of the transformations involved and is led to see why homogeneous coördinates are so useful, he will appreciate the power of his methods and will see in them a genuine beauty probably new to him in mathematical experience.

Courses *A* and *D* can best be studied together. In course *A* should be included an introduction to the theory of functions of a real and of a complex variable. It might also contain some of the easier parts of the theory of ordinary differential equations. Course *D* will include material useful in course *A* and in fact in any further work in pure mathematics. The importance of this course as an introduction to further work in mathematics cannot be over-emphasized and yet the material can be grasped by a college senior whose ability justifies continuing the study of mathematics.

An immediate objection to such a set of courses is the difficulty of finding text-books. Course *C* would not be so troublesome in this respect. As for course *B*, it seems to the writer that it is time for a book to appear dealing with methods in modern geometry from the bottom up (from the student's point of view) rather than from the top down. The material of courses *A* and *D* is such that if the instructor knows it well enough to teach it without a book, the student will be much better off if he makes his own text-book from careful notes; while if the instructor does not know it thoroughly, a text would be of little value and he better not attempt to give the courses.

There is room for much more coöperation than at present exists between the colleges of the type in question and the graduate schools in the study of mathematics. Since the only equipment essential for the mathematics department is the instructor and the blackboard, there is no reason why first class introductory work in advanced mathematics should not be done in a great many of our colleges. On the other hand, the demand for graduate instruction in mathematics is so small and the opportunities at the few large graduate schools are such that it is rarely wise for a graduate student to study at a place where he commands the

attention of very few men who are giving their best efforts to research in mathematics. For this reason, the type of college here considered has a most important work in opening the eyes of the student to the possibilities ahead of him and in giving him definite, essential tools with which to work; but such a college blunders if, instead, it tries to give more specialized courses which demand for their full appreciation a preparation which the student cannot have had.

29. While studying the problem of two equal rough bodies, connected by an inelastic wire, resting on an inclined plane, Professor Clifford N. Mills of South Dakota State College met the following interesting expression. If $1/a$ and $1/(a+1)$ are the coefficients of friction, the tension of the wire when the bodies are about to descend becomes a multiple of $\frac{1}{2}[1/a + 1/(a+1)]$. This, when simplified, becomes $(2a+1)/2a(a+1)$. If $2a+1$ and $2a(a+1)$ represent the base and altitude of a right triangle, the hypotenuse is $2a^2+2a+1$. Therefore, this gives a series of numbers which satisfy the relation $x^2+y^2=z^2$, if a is given any value whatsoever. Professor Mills desires to know if this will give all the integers which satisfy the condition that the sum of the squares of two integers equals the square of an integer.

REPLY BY S. LEFSCHETZ, University of Kansas.

If the integers x, y, z , form a Pythagorean set, that is, if they satisfy the relation $x^2 + y^2 = z^2$, then it is well known* that there can be found three other integers m, n, p , such that $x = p(m^2 - n^2)$, $y = 2pmn$, $z = p(m^2 + n^2)$. For $m = a+1$, $n = a$, $p = 1$ the special solution indicated by Professor Mills is obtained.

NOTES AND NEWS.

EDITED BY D. A. ROTHROCK, Indiana University.

PROFESSOR PAUL PAINLEVÉ, of the department of mathematics in the University of Paris, is minister of education in the present French cabinet.

Henry Holt and Company have just published a "Plane Analytic Geometry," by PROFESSOR MAXIME BÔCHER. The last two chapters are devoted to calculus.

Ginn and Company have published "Problems in the Calculus," by DR. D. D. LEIB of the Sheffield Scientific School, Yale University, also "The Theory of Invariants," by PROFESSOR O. E. GLENN, of the University of Pennsylvania.

The sixteenth in the series of Wiley's Mathematical Monograph Series appears as "Diophantine Analysis," by Professor ROBERT D. CARMICHAEL. The same firm has recently published an "Analytic Geometry," by PROFESSOR H. B. PHILLIPS, of the Massachusetts Institute of Technology.

Junior Professors PETER FIELD, L. C. KARPINSKI and T. R. RUNNING have been promoted to associate professorships of mathematics at the University of Michigan, and DRs. T. FORT and T. H. HILDEBRANDT to assistant professorships

* Cf. Bachman, *Zahlentheorie*, Vol. I, p. 192. Also Carmichael, *Diophantine Analysis*, pp. 8-13.